

1. A wiring structure wherein the wiring structure is so constituted that, in a wiring structure of multi-layered wiring in which a plurality of unit wiring structures are laminated, the unit wiring structure having at least one metal wiring and at least one metal connection plug formed by filling the metal into a wiring trench and a via hole formed in an insulation film on a substrate forming a semiconductor element, at least one of the unit wiring structures includes an insulation barrier layer with organic substance inserted between at least one of the metal wiring and the metal connection plug, and an interlayer insulation film, at least a portion of a side surface of at least one of the metal wiring and the metal connection plug being overlaid by the insulation barrier layer.

2. The wiring structure according to the claim 1 wherein said insulation barrier layer further includes silicon atoms.

3. The wiring structure according to the claim 1 or the claim 2 wherein said metal is copper, said metal wiring is a copper wiring, and said metal connection plug is a copper connection plug.

4. The wiring structure according to the claim 3 wherein an interlayer insulation film in which a first insulation film, a porous insulation film and a second insulation film are laminated in series, is formed on at least one of the copper wiring and the copper connection plug, at least a portion of a side surface of at least one of a wiring trench and a via hole formed through the first insulation film, the porous insulation film and the second insulation film being overlaid by the insulation barrier layer including the organic substance, and carbon content of the organic substance being preferably larger than that of the first insulation film and the second insulation film.

5. The wiring structure according to the claim 3 wherein an interlayer insulation film in which a first insulation film, a third insulation film, a fourth insulation film, a porous insulation film and a second insulation film are laminated in series, is formed on the copper

wiring, a side surface of a wiring trench formed through at least the second insulation film and the porous insulation film, and a side surface of a via hole formed through the fourth insulation film, a via interlayer insulation film and the first insulation film being overlaid by the insulation barrier layer including the organic substance, and carbon content of the organic substance being preferably larger than that of the first insulation film, the second insulation film and the fourth insulation film.

6. The wiring structure according to the claim 4 or the claim 5 wherein the porous insulation film is made of a porous film having relative dielectric constant no greater than 3.0.

7. The wiring structure according to either one of the claim 4 to the claim 6 wherein the insulation barrier layer further includes silicon atoms.

8. The wiring structure according to the claim 5 wherein the insulation barrier layer including the organic substance includes silicon atoms in the range smaller than the first insulation film, the second insulation film and the fourth insulation film.

9. The wiring structure according to the claim 4 or the claim 8 wherein the third insulation film and the fourth insulation film are made of the same material.

10. The wiring structure according to either one of the claim 1 to 9 wherein the insulation barrier layer including the organic substance is made of organic substance including Si-O binding.

11. The wiring structure according to either one of the claim 1 to 10 wherein the insulation barrier layer including the organic substance is made of organic substance including Silicon in the range of 1 atm % to 10 atm %.

12. The wiring structure according to either one of the claim 1 to 11

wherein the insulation barrier layer including the organic substance is made of a Divinyl Siloxane Benzo Cyclobutene film.

13. The wiring structure according to the claim 4 wherein the insulation barrier layer including the organic substance is made of a Divinyl Siloxane Benzo Cyclobutene film, the first insulation film is made of a SiCN film, the second insulation film is made of a SiO₂ film, the porous insulation film is made of a porous SiOCH film, the third insulation film is made of a porous SiOCH film, and the fourth insulation film is made of a SiO₂ film.

14. The wiring structure according to the claim 5 wherein the insulation barrier layer including the organic substance is made of a film of Divinyl Siloxane Benzo Cyclobutene, the first insulation film is made of a SiCN film, the second insulation film is made of a SiO₂ film, the porous insulation film is made of a porous SiOCH film, the third insulation film is made of a porous SiOCH film, and the fourth insulation film is made of a SiO₂ film.

15. The wiring structure according to the claim 5 wherein the insulation barrier layer including the organic substance is made of a film of Divinyl Siloxane Benzo Cyclobutene, the first insulation film is made of a SiCN film, the second insulation film is made of a SiO₂ film, the porous insulation film is made of a porous SiOCH film, the third insulation film is made of a nonporous SiOCH film, and the fourth insulation film is made of a SiO₂ film.

16. The wiring structure according to either one of the claim 1 to 15 wherein the insulation barrier layer including the organic substance is made of carbon, silicon and organic substance.

17. The wiring structure according to the claim 4 or the claim 5 wherein both of the first insulation film and the second insulation film are made of the same material.

18. The wiring structure according to the claim 4 or the claim 5

wherein both of the first insulation film and the second insulation film are made of the same material, and made of either one of SiCN, SiC, SiCNH, SiCH and SiOCH.

19. A wiring structure wherein the wiring structure is so constituted that, in a wiring structure with a multi-layered wiring formed in an insulation film on a semiconductor substrate, which is provided with a metal wiring including Cu as a main component formed through a porous insulation film and a second insulation film laid on the porous insulation film, and a first insulation film formed on the second insulation film, the first insulation film and the second insulation film, are made of the same material.

20. The wiring structure according to the claim 19 wherein the same material constituting the first insulation film and the second insulation film is made of either one of material including silicon carbide as a main component, material including silicon nitride as a main component and material including silicon carbonitride as a main component.

21. A method for manufacturing a multi-layered wiring in which a plurality of unit wiring structures are laminated, the unit wiring structure having a wiring and a connection plug formed by filling metal including Cu as a main component into a wiring trench and a via hole formed in an insulation film on a substrate forming a semiconductor element, the method including the processes of,

a process for forming a first insulation film directly contacting on the copper wiring or the copper connection plug and a porous insulation film laid on the first insulation film,

a process for forming a second insulation film laid on the porous insulation film,

a process for forming a wiring trench or a via hole in the second insulation film and the porous insulation film,

a process for forming an insulation barrier layer including organic substance at upper surface, side surface and bottom surface of a wiring structure sectioned by the wiring trench or the via hole,

a process for etching back the insulation barrier layer including organic substance and removing the insulation barrier layer including organic substance remaining on the upper surface and bottom surface portions of the wiring structure, and
a process for embedding a metal film in the wiring structure trench or the via hole.

22. A method for manufacturing a multi-layered wiring in which a plurality of unit wiring structures are laminated, the unit wiring structure having a wiring and a connection plug formed by filling metal including Cu as a main component into a wiring trench and a via hole formed in an insulation film on a substrate forming a semiconductor element, the method including the processes of,

a process for forming a first insulation film, a third insulation film, a fourth insulation film, a porous insulation film and a second insulation film by laminating in series on a copper wiring,

a process for forming a wiring trench in the porous insulation film and the second insulation film,

a process for forming a via hole in the third insulation film and the fourth insulation film,

a process for forming an insulation barrier layer including organic substance at upper surface, side surface and bottom surface of the wiring structure sectioned by the wiring trench and the via hole,

a process for etching back the insulation barrier layer including organic substance and removing the insulation barrier layer including organic substance remaining on the upper surface and bottom surface of the wiring structure,

a process for removing the first insulation film on the bottom of the via hole in the wiring structure, and

a process for embedding a metal film in the wiring trench and the via hole.

23. The method for manufacturing a multi-layered wiring according to the claim 21 or the claim 22 wherein said insulation barrier layer including the organic substance is formed by the plasma polymerization method.